In Re PATENT APPLICATION of

Applicant: Philipp **Docket:** PST
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Art Unit: 2858 **Examiner:** Natalini, J. W.
Title: Charge Transfer Capacitive Position Sensor

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TO: Commissioner for Patents
P O Box 1450
Alexandria, VA 22313-1450

A. Introductory Comments

In reply to an Office Action mailed on 04/05/2006, please enter the following amendments.

B. Amendments to the Claims

Claim 1(currently amended) A capacitive sensor for providing a detection output indicative of proximity to a sensing body extending between two electrodes of an object that is not a portion of the sensor and for providing a position output ~~representative~~ varying linearly with ~~of~~ a position of the object along [[a]] the sensing body ~~at which~~ when the object is proximate ~~the sensing body~~ thereto, the sensor comprising:

two capacitive sensing channels, each channel connected to a respective one of the electrodes, each channel having a respective channel output representative of a respective non-linear response to a capacitive load imposed by the object when the object is proximate the body;

means for operating the two channels synchronously;

means for summing the respective channel outputs and for providing the detection output if that sum exceeds a selected minimum threshold; and

calculation means for receiving the respective outputs from the two channels, for calculating a ratio of a selected linear combination of the outputs of the two channels, wherein the ratio varies linearly with the position of the object, and for supplying the ratio as the position output.

Claim 2 (original) The sensor of Claim 1 wherein the respective output from each of the channels comprises an algebraic difference between a respective first value measured when the object is adjacent the sensing body and a respective second value measured when the object is distal therefrom.

Claim 3 (original) The sensor of Claim 1 wherein the object is capacitively coupled to an electrical ground.

Claim 4(original) The sensor of Claim 1 wherein each sensing channel comprises:

a respective sample capacitor having two terminals, one of which is connected to the associated electrode by means not comprising an electric switching element;

three electric switching elements, each of the three switching elements having both a single respective closed state for connecting one of the terminals of the respective sample capacitor to only one of two different reference voltages, each of the respective switching elements further having a respective open state in which it does not connect the respective one of the terminals to either of the two reference voltages; and

a respective measurement circuit for supplying the respective channel output responsive to a voltage measurement at a selected one of the terminals of the respective sample capacitor.

Claim 5(original) The sensor of Claim 1 further comprising a plurality of electric switching elements, wherein each sensing channel comprises:

a respective sample capacitor having two terminals, one of which is connected to a respective electrode by means not comprising one of the electric switching elements;

at least one respective electric switching element of the plurality thereof for resetting the respective sample capacitor by connecting both of its terminals to a first selected reference

voltage; and

at least two additional respective switching elements of the plurality thereof for alternately switching one of the two terminals of the respective sample capacitor to the first selected reference voltage and the second of the two terminals to a second selected reference voltage.

Claim 6(original) The sensor of Claim 1 wherein:

each channel comprises a respective resistor-capacitor pair and means for measuring a parameter change at the associated electrode;

the means for operating the two channels synchronously comprises a controller for controlling at least three electric switching elements; wherein

two of the at least three electric switching elements are operable by the controller to simultaneously connect both of the two electrodes to a first reference voltage; and wherein

at least a third of the at least three electric switching elements is operable to simultaneously connect a second reference voltage to each resistor-capacitor pair.

Claim 7(original) The sensor of Claim 1 wherein each of the channels comprises a sampling capacitor whose voltage rises in an inverse exponential fashion with a capacitive load.

Claim 8(original) The sensor of Claim 1 wherein the calculation means comprises a microcontroller and the means for operating the channels synchronously comprises a plurality of switching elements controlled by the microcontroller.

Claim 9(original) The sensor of Claim 1 wherein the sensing body comprises two strips of conductive material extending adjacent to each other with a gap therebetween, wherein at least one of the strips tapers along its length.

Claim 10(original) The sensor of Claim 1 wherein the sensing body comprises a single resistor.

Claim 11(original) The sensor of Claim 1 wherein the sensing body comprises a plurality of discrete resistors connected in series.

Claim 12(canceled)

Claim 13 (currently amended) A capacitive sensor for providing a detection output indicative of proximity of an object and for ~~sensing~~ providing a position output varying linearly with a position of the object along a sensing body extending between two electrodes, the sensor comprising:

two sensing channels respectively connected to the two electrodes, each sensing channel

comprising:

a respective sample capacitor having two terminals, one of which is connected to the associated electrode by means not comprising an electric switching element;

three electric switching elements, each of the three switching elements having both a single respective closed state for connecting one of the terminals of the respective sample capacitor only to one of two different reference voltages, each of the respective switching elements further having a respective open state in which it does not connect the respective one of the terminals to either of the two reference voltages; and

a respective measurement circuit for supplying an output responsive to a measurement of a respective capacitive load imposed by the object at a selected one of the terminals of the respective sample capacitor, said output varying non-linearly with the position of the object along the sensing body when the object is proximate the sensing body and the sensor is in operation;

a switch controller for selectively opening and closing the switching elements;

means for summing the respective outputs from the two measurement circuits and for providing the detection output if the sum exceeds a stored minimum threshold value ; and

means for calculating the position of the object from a ratio of a selected linear combination of the respective non-linear outputs of the two measurement circuits.

Claim 14 (previously presented) The sensor of Claim 13 wherein the means for calculating the position of the object comprises a microcontroller.

Claim 15(canceled)

Claim 16 (previously presented) The sensor of Claim 13 wherein the sensing body comprises a single resistor.

Claim 17 (previously presented) The sensor of Claim 13 wherein the sensing body comprises a plurality of discrete resistors connected in series.

Claim 18 (currently amended) A capacitive sensor for providing a detection output indicative of proximity of an object and for ~~sensing~~ providing a position output that varies linearly with a position of the object along a sensing body extending between two electrodes, the sensor comprising:

a switch controller for selectively closing ones of a plurality of electric switching elements;

two sensing channels having respective inputs from the electrodes and having respective outputs from respective associated measurement circuits, each of the respective outputs responsive to a capacitive load imposed by the object, each of the respective outputs varying non-linearly with the position of the object along the sensing body when the object is

proximate the sensing body and the sensor is in operation, each of the sensing channels comprising

a respective sample capacitor having two terminals, one of which is connected to a respective electrode by means not comprising one of the electric switching elements;

at least one respective electric switching element of the plurality thereof for resetting the respective sample capacitor by connecting both of its terminals to a first selected reference voltage;

at least two additional respective switching elements of the plurality thereof for alternately switching one of the two terminals of the respective sample capacitor to the first selected reference voltage and the second of the two terminals to a second selected reference voltage;

means for summing the respective outputs from the two measurement circuits and for providing the detection output if the sum exceeds a selected minimum threshold value; and

a means for calculating the position of the object from a ratio of a selected linear combination of the respective non-linear outputs of the two measurement circuits.

Claim 19 (previously presented) The sensor of Claim 18 wherein the means for calculating the position of the object comprises a microcontroller.

Claim 20(canceled)

Claim 21(previously presented) The sensor of Claim 18 wherein the sensing body comprises two strips of conductive material extending adjacent to each other with a gap therebetween, wherein at least one of the strips tapers along its length.

Claim 22(previously presented) The sensor of Claim 18 wherein the sensing body comprises a single resistor.

Claim 23(previously presented) The sensor of Claim 18 wherein the sensing body comprises a plurality of discrete resistors connected in series.

Claims 24 – 28 (canceled)

Claim 29 (withdrawn) A capacitive sensor for providing, at a time when an object that is not a part of the sensor is proximate thereto, an output representative of a position of the object along a sensing body extending between two electrodes, the sensor comprising:

two capacitive sensing channels, each channel connected to a respective one of the electrodes, each channel having a respective channel output representative of a respective non-linear response to a capacitive load imposed by the object when the object is proximate the body, each channel having a respective reference output when the object is not proximate the body;

means for operating the two channels synchronously,

means for storing the respective reference outputs, and

calculation means for receiving the respective outputs from the two channels, for calculating a respective difference between each channel output and the respective stored reference output associated therewith, and for calculating a ratio of a selected one of the differences to a sum of the differences, wherein the ratio varies linearly with the position of the object, and for supplying the ratio as the output representative of the position.

C. Remarks

1) The three independent claims are amended to point out that the claimed invention is drawn to an arrangement providing a measure of distance along a sensing body where the measure varies linearly with the distance. This is inherently a one-dimensional measurement – i.e., the invention provides measurement of distance along a straight line or a curve, where the line or curve is defined by some sort of sensing body having a finite width and extending between two electrodes.

The Hepworth reference describes an arrangement directed at providing a highly non-linear output (e.g., as shown in Fig. 4 therein) for determining the location of a single point – i.e., the mid-point of a wall stud – rather than for measuring the position of an object along a sensing body. Thus, Hepworth teaches away from Applicant's claimed subject matter.

As the CAFC has noted, :[i]t is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor." Northern Telecom, Inc. v. Datapoint Corp., 15 USPQ2d 1321, 1323 (CAFC 1990). Thus the Examiner "cannot pick and choose among the individual elements of assorted prior art references to recreate the claimed invention," but "has the burden to show some teaching or suggestion in the references to support their use in the particular claimed combination." Smithkline Diagnostics Inc. v. Helena Laboratories Corp., 8 USPQ2d 1468, 1475 (CAFC 1988). Inasmuch as the Hepworth reference is related to systems for sensing a specific condition (classified in Class 340, subclass 540) it is not clear that someone having ordinary technical skill in subject application's art of measuring distance by capacitive means (Class 324, subclass 662), would be aware of the Hepworth teaching, let alone be motivated to combine it with the teachings of the references by Philipp and Shahoian et al.

These amendments and arguments are believed to traverse the Examiner's rejection of all pending claims under 35 USC §103(a) over Philipp '707 in view of the cited combinations of the Shahoian et al., Hepworth, Philipp'036, Brandt and Bloom references. Reconsideration is

requested.

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